SUMMARY REPORT
HABITAT PROTECTION AND ECOSYSTEM-BASED MANAGEMENT COMMITTEE

DoubleTree by Hilton Atlantic Beach Oceanfront
Atlantic Beach, NC

December 5, 2016

The Committee met December 5, 2016 and addressed the following items: (A) A report on the November 15-16, 2016 Habitat Ecosystem Advisory Panel Meeting (B) Draft EFH Policy Statements for South Atlantic Food Web and Connectivity and South Atlantic Climate Variability and Fisheries and an update on the Artificial Reef EFH Policy Statement development (D) Update on habitat and ecosystem tools and modeling and (E) The Final Lenfest Fishery Ecosystem Task Force Report.

Habitat Protection and Ecosystem Advisory Panel Report Pat Geer, GDNR Chair of the Habitat Protection and Ecosystem Based Management Advisory Panel provided a report on the November 15-16, 2016 Habitat Ecosystem Advisory Panel Meeting

FEP II Development: EFH Policy Statements for South Atlantic Food Web and Connectivity and Fisheries and South Atlantic Climate Variability and Fisheries
Pat Geer, GDNR and Council staff, reviewed draft EFH Policy Statements for South Atlantic Food Web and Connectivity and South Atlantic Climate Variability and Fisheries for inclusion into FEP II. In addition, Pat Geer provided an update on development of an Artificial Reef Policy Statement.
Policy Statements included in this report were updated based on Committee input and completed for Council Consideration:

Habitat and Ecosystem Modeling and Tool Development
Council staff provided an update on activities supporting habitat and ecosystem tool development and modeling in cooperation with regional partners.

Presentation on Lenfest Task Force Report
Michelle Duval serving as an Advisory Panel member introduced Phil Levin, Co-Chair of the Lenfest Task Force to introduce the effort and context of development of the Report. Felicia Coleman, with Florida State University and Task Force Member provided the Committee a presentation on the Final Lenfest Fishery Ecosystem Task Force Report, Building Effective Fishery Ecosystem Plans.

No Motions were made by the Committee however staff revised the EFH Policy Statements based on Committee recommendations for Council consideration and approval.

COUNCIL ACTION:
MOTION #1: Approve EFH Policy Statement for South Atlantic Climate Variability and Fisheries giving staff and Council Chairman editorial license to finalize for inclusion into FEP II
APPROVED BY COUNCIL

MOTION: Approve EFH Policy Statement for South Atlantic Food Web and Connectivity giving staff and Council Chairman editorial license to finalize for inclusion into FEP II
APPROVED BY COUNCIL

TIMING AND TASK MOTION:

- Council staff will finalize the EFH Policy Statements for South Atlantic Food Web and Connectivity and South Atlantic Climate Variability and Fisheries for integration into FEP II and posting to the Council website.
- Council staff will support FEP II writing team members development and the Habitat Protection and Ecosystem Based Management Advisory Panel completion of the draft EFH Policy Statement for Artificial Reefs during their Spring 2017 meeting.
- Council staff will, building on FEP II Managed Species Team input, advance development of the South Atlantic Mapping Strategy by facilitating a meeting of SEAMAP Habitat Characterization and Species Assessment Workgroup.
- Council staff will continue collaboration between SAFMC, SCDNR (SEAMAP/MARMAP) and Ocean Areo in planning for a potential in water test of the Submarin AUV in conjunction with a 2017 research cruise.

APPROVED BY COUNCIL

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Draft
POLICY CONSIDERATIONS FOR SOUTH ATLANTIC CLIMATE VARIABILITY AND FISHERIES AND ESSENTIAL FISH HABITATS
(December~~November~~ 2016)

Introduction

This document provides guidance from the South Atlantic Fishery Management Council (SAFMC) regarding South Atlantic Climate Variability and Fisheries and the protection of Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (EFH-HAPCs) supporting the Council move to Ecosystem Based Fishery Management. The guidance is consistent with the overall habitat protection policies of the SAFMC as formulated and adopted in the Habitat Plan (SAFMC 1998a), the Comprehensive EFH Amendment (SAFMC 1998b), the Fishery Ecosystem Plan of the South Atlantic Region (SAFMC 2009a), Comprehensive Ecosystem-Based Amendment 1 (SAFMC 2009b), Comprehensive Ecosystem-Based Amendment 2 (SAFMC 2011), and the various Fishery Management Plans (FMPs) of the Council.

For the purposes of policy, the findings assess potential threats and impacts to managed species EFH and EFH-HAPCs and the South Atlantic ecosystem associated with climate variability or change and processes that could improve those resources or place them at risk. The policies and recommendations established in this document are designed to address such impacts in accordance with the habitat policies of the SAFMC as mandated by law. The SAMFC may revise this guidance in response to 1) changes in conditions in the South Atlantic region, 2) applicable laws and regulatory guidelines,~~ and~~ 3) new knowledge about the impacts or 4) as deemed as appropriate by the Council.

Policy Considerations

The marine environment is constantly in flux and today, many parts of the ocean are changing quickly due to such factors as varying temperatures and salinities, fluctuating productivity, rising sea levels, ocean acidification and growing coastal populations. While the extent and types of changes occurring vary from region to region, these changes are a major driver of ecosystem dynamics and the impacts are already being observed by scientists, managers, and fishermen in the South Atlantic.

Fish populations can react to changing ocean conditions. For example, as the ocean warms, many fish species are expanding their range or shifting their distributions toward the poles or into deep areas to find cooler waters[1]. Changes in spawning location and timing could have cascading effects, such as changes in population size, stock structure and population connectivity[2]. Research indicates that winter severity is also emerging as an important factor shaping fish assemblages and distribution patterns in this region[3]. In the South Atlantic, black sea bass are being caught further south off Florida and Walker 2016 documented an increase in probability of occurrence in recent years around Cape Canaveral Florida which could be related to cooler near surface water resulting from more frequent upwelling events in recent years.black sea bass are being caught further south off Florida which is thought to be related to cooler near surface water resulting from more frequent upwelling events in recent years. Such events need to be investigated comprehensively. Scientists are also observing changes in the distribution of cobia which are shifting northwards during their spring migration[4]. As conditions change and fluctuate, other South Atlantic fish populations could follow suit. Changing ranges are particularly important as fish movements into other jurisdictions can affect existing management plans and perhaps require modification of the existing management strategies.

Along with north-south (latitudinal) changes in distribution, vertical (depth) changes in the distribution of fish are affecting the catchability of the resources in terms of availability and vulnerability. These changes are particularly important for fishermen and the stock assessment process, for which changes in catch rates are assumed to be linearly related to changes in abundance. The effects of environment on stock dynamics need to be parsed into those which affect catchability – which tend to obscure true abundance signals – and those factors which actually lead to change stock abundance. Differentiating between these effects involves the changes in development of quantitative catchability coefficients derived from environmental data, and is becoming increasingly important with climate change.

Changing ocean conditions have the potential to alter existing fisheries and create opportunities for new fisheries in different regions and in South Atlantic region. Sometimes this can happen before managers have an opportunity to assess impacts of the new fishery on the ecosystem and legislate appropriate management measures. For example, there is a developing fishery for cannonball jellyfish off the South Atlantic coast but there is little information on the possible ecosystem impacts of these fisheries[5]. As climate variability leads to range expansions and distribution shifts, new opportunities

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[1] M. C. Jones, W. W. L. Cheung. 2014. Multi-model ensemble projections of climate change effects on global marine biodiversity. *ICES Journal of Marine Science*,DOI: 10.1093/icesjms/fsu172

[2] Hare J., Alexander M., Fogarty M., Williams E., Scott J. 2010. Forecasting the dynamics of a coastal fishery species using a coupled climate-population model. Ecological Applications. 20(2):452-464.

[3] H.J. Walsh, D.E. Richardson, K.E. Marancik, and J.A. Hare. 2015. Long-term changes in the distributions of larval and adult fish in the Northeast U.S. shelf ecosystem. PLOS One. DOI:10.1371/journal.pone.0137382.

[4] J.W. Morley, R. D. Batt, and M. L. Pinsky (in review). Marine assemblages respond rapidly to winter climate variability.

[5] Pinsky, M. L., B. Worm, M. J. Fogarty, J. L. Sarmiento, and S. A. Levin. 2013. Marine taxa track local climate velocities. Science 341: 1239-1242 doi: 10.1126/science.1239352

[6] http://coastalgadnr.org/sites/uploads/crd/pdf/FMPs/CannonballFMP.pdf

may develop and exploiting these opportunities could have a cascading effect on other fish species and habitats, highlighting the need for a precautionary approach.

Changing ocean chemistry, in particular the impact of ocean acidification, has the potential to change food webs in the region. Ocean acidification appears likely to have significant consequences because many species which depend on calcium metabolism serve as prey or provide habitat, including mollusks, diatoms, soft and hard corals, and crustacean larvae; indeed direct impacts in other regions have already included shellfish mortality.

Around the nation, scientists and managers are formulating management strategies for changing ocean conditions[6]. In 2009, the North Pacific Fishery Management Council banned all commercial fishing in the changing Arctic until more scientific information is available and the Council is able to evaluate potential impacts. In 2014, the Mid-Atlantic Fishery Management Council, in coordination with the South Atlantic Fishery Management Council, New England Fishery Management Council, and Atlantic States Marine Fisheries Council, held a workshop to examine the potential impacts of climate change and the associated management implications. They underscored the importance of fostering ecological resilience to develop "climate-ready" fisheries, fishing communities, stock assessment, and management strategies[7]. The 2015 National Science and Statistical Committee meeting also focused on incorporating climate variability into stock assessments and fisheries management as one of its meeting themes[8]. Currently, NOAA is developing Regional Action Plans (RAPs) to guide and increase the use of climate-related information necessary to manage marine resources[9]. The extent and degree of changes expected in the South Atlantic are not fully known and the consequences of these changes cannot always be predicted. Such changes have implications for both stock assessments and fisheries management decisions.

Threats to EFH and EFH-HAPCs from Climate Variability

The SAFMC finds that climate variability in the South Atlantic impacts EFH and EFH-HAPCs and fisheries for managed species. Table 1 following climate variability policy and research recommendations, presents a summary of fisheries and habitat designations potentially affected by climate variability in the South Atlantic as presented in the SAFMC EFH User Guide ~~Region~~(http://safmc.net/download/SAFMCEFHUsersGuideFinalNov16.pdf).

SAFMC Policies Addressing South Atlantic Climate Variability and Fisheries

The SAFMC establishes the following policies to address South Atlantic climate variability and fisheries, and to clarify and augment the general policies already adopted

[7] M. L. Pinsky and N. J. Mantua, 2014. Emerging Adaptation Approaches for Climate-Ready Fisheries. Oceanography 27(4): 147-159.
[8] MAFMC 2014. A Workshop Report: East Coast Climate Change and Governance Workshop Report. March 19-21, 2014. Washington, DC.
[9] http://www.wpcouncil.org/wp-content/uploads/2015/01/DRAFT-2015-National-SSC-Workshop-Timed-Agenda.pdf
[10] https://www.st.nmfs.noaa.gov/ecosystems/climate/rap/index

in the Habitat Plan and Comprehensive Habitat Amendment and Fishery Ecosystem Plan (SAFMC 1998a; SAFMC 1998b; SAFMC 2009a).

General Policies:

1. As species expand/shift their distributions due to changing ocean conditions and/or market demands, it is the Council's policy that the SAFMC will proactively work with:
    a. State agencies, other Councils, Atlantic State Fishery Commission, NOAA Fisheries to manage species that span multiple jurisdictions.
    b. South Atlantic LCC, NOAA RISAs, Southeast Climate Science Center, and other multi-organizational partnerships.
    c. The fishing industries, fishing communities, and other interested civil stakeholders.

2. A priority list of climate indicators should be developed by NOAA or regional partners or selected that likely track ecological, social, and economic trends and status. The Council requests annual summaries of these indicators, species likely to be influenced, and fisheries trends that appear to be due to changing ocean environmental conditions in the South Atlantic ecosystem.

3. Climate change requires the consideration of tradeoffs. Changing ocean conditions necessitate responses ranging from increasing buffers due to a higher level of uncertainty to adjusting quotas upward or downward to account for predicted and realized increases or decreases in productivity.

4. Given the uncertainty of climate impacts, the precautionary principle should be invoked as possible for future management decisions on issues that can be influenced by climate change.

~~5. New fisheries can develop before managers are able to adequately monitor or control them. One avenue to avoid uncontrolled removal where species have no limits is to include them in an aggregate bag limit.~~

~~6.~~5. Careful scientific and management evaluation should be undertaken as new fisheries develop, including consideration of how to avoid harmful impacts on essential fish habitat.

Research Needs Addressing Climate Variability ~~and Change~~

1. Scientific research and collection of data to further understand the impacts of climate variability on the South Atlantic ecosystem and fish productivity must be prioritized. This includes research on species vulnerabilities in terms of distribution, habitat, reproduction, recruitment, growth, survival, and predator-prey interactions.

2. As appropriate, climate data and the effects of climate variability should be integrated into stock assessments. Climate impacts could also be a focus of the new proposed stock assessment research cycle.

3. More three dimensional ocean observations of ocean conditions are needed to characterize the coastal- estuarine – ocean habitats.

4. Management Strategy Evaluations are desired to allow the Council to analyze potential regional climate scenarios and determine whether current harvest strategies are robust to future changes.

5. Greater understanding of the socio-economic impacts and fisheries responses to climate variability is needed.

~~6. Greater understanding of the social impacts and fisheries responses to climate variability is needed.~~

~~7.~~ 6. Characterization of offshore ocean habitats used by estuarine dependent ~~diadromous~~ species which may be useful in developing ecosystem models.

Many of the habitats and associated fisheries affected by climate variability in the South Atlantic Region have been identified as EFH-HAPCs by the SAFMC as follows:

Table 1. Fisheries and Habitat Designations Potentially Affected by Climate Variability in the South Atlantic Region (Source: SAFMC EFH Users Guide 2016).

Essential Fish Habitat	Fisheries/Species	EFH- Habitat Areas of Particular Concern
Wetlands		
Estuarine and marine emergent wetlands	Shrimp, Snapper Grouper	Shrimp: State designated nursery habitats Mangrove wetlands
Tidal palustrine forested wetlands	Shrimp	
Submerged Aquatic Vegetation		
Estuarine and marine submerged aquatic vegetation	Shrimp, Snapper Grouper, Spiny lobster	Snapper Grouper, Shrimp
Shell bottom		
Oyster reefs and shell banks	Snapper Grouper	Snapper Grouper
Coral and Hardbottom		
Coral reefs, live/hardbottom, medium to high rock outcroppings from shore to at least 600 ft where the annual water temperature range is sufficient.	Snapper Grouper, Spiny lobster, Coral, Coral Reefs and Live Hard/bottom Habitat	The Point, Ten Fathom Ledge, Big Rock, MPAs; The *Phragmatopoma* (worm reefs) off central east coast of Florida and nearshore hardbottom; coral and hardbottom habitat from Jupiter through the Dry Tortugas, FL; Deepwater CHAPCs
rock overhangs, rock outcrops, manganese-phosphorite rock slab formations, and rocky reefs		Snapper-grouper [blueline tilefish]
Artificial reefs	Snapper Grouper	Special Management Zones
Soft bottom		
Subtidal, intertidal non-vegetated flats	Shrimp	
Offshore marine habitats used for spawning and growth to maturity	Shrimp	
Sandy shoals of capes and offshore bars	Coastal Migratory Pelagics	Sandy shoals; Capes Lookout, Fear, Hatteras, NC; Hurl Rocks, SC;
troughs and terraces intermingled with sand, mud, or shell hash at depths of 150 to 300 meters		Snapper-grouper [golden tilefish]
Water column		
Ocean-side waters, from the surf to the shelf break zone, including Sargassum	Coastal Migratory Pelagics	
All coastal inlets	Coastal Migratory Pelagics	Shrimp, Snapper-grouper
All state-designated nursery habitats of particular importance (e.g., PNA, SNA)	Coastal Migratory Pelagics	Shrimp, Snapper-grouper
High salinity bays, estuaries	Cobia in Coastal Migratory Pelagics	Spanish mackerel: Bogue Sound, New River, NC; Broad River, SC
Pelagic Sargassum	Dolphin	
Gulf Stream	Shrimp, Snapper-grouper, Coastal Migratory Pelagics, Spiny lobster, Dolphin-wahoo	
Spawning area in the water column above the adult habitat and the additional pelagic environment	Snapper-grouper	

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J.W. Morley, R. D. Batt, and M. L. Pinsky (in review). Marine assemblages respond rapidly to winter climate variability. http://www.nmfs.noaa.gov/stories/2014/12/oceanadapt_trackingfish.html

Pinsky, M. L., B. Worm, M. J. Fogarty, J. L. Sarmiento, and S. A. Levin. 2013. Marine taxa track local climate velocities. Science 341: 1239-1242 doi: 10.1126/science.1239352

SAFMC. 1998a. Final Habitat Plan for the South Atlantic region: Essential Fish Habitat requirements for fishery management plans of the South Atlantic Fishery Management Council. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, SC 29407-4699. 457 pp. plus appendices.

SAFMC. 1998b. Final Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region. Including a Final Environmental Impact Statement /Supplemental Environmental Impact Statement, Initial Regulatory Flexibility Analysis, Regulatory Impact Review, and Social Impact Assessment/Fishery Impact Statement. South Atlantic Fishery Management Council, 1 Southpark Cir., Ste 306, Charleston, SC 29407-4699. 136pp.

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Draft

POLICY CONSIDERATIONS FOR SOUTH ATLANTIC FOOD WEBS AND CONNECTIVITY AND ESSENTIAL FISH HABITATS

(December~~November~~ 2016)

Introduction

This document provides guidance from the South Atlantic Fishery Management Council (SAFMC) regarding South Atlantic Food Webs and Connectivity and the protection of Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (EFH-HAPCs) supporting the Council move to Ecosystem Based Fishery Management. The guidance is consistent with the overall habitat protection policies of the SAFMC as formulated and adopted in the Habitat Plan (SAFMC 1998a), the Comprehensive EFH Amendment (SAFMC 1998b), the Fishery Ecosystem Plan of the South Atlantic Region (SAFMC 2009a), Comprehensive Ecosystem-Based Amendment 1 (SAFMC 2009b), Comprehensive Ecosystem-Based Amendment 2 (SAFMC 2011), and the various Fishery Management Plans (FMPs) of the Council.

For the purposes of policy, the findings assess potential threats and impacts to managed species EFH and EFH-HAPCs and the South Atlantic ecosystem associated with changes in food webs and connectivity and processes that could improve those resources or place them at risk. The policies and recommendations established in this document are designed to address such impacts in accordance with the habitat policies of the SAFMC as mandated by law. The SAMFC may revise this guidance in response to 1) changes in conditions in the South Atlantic region, 2) applicable laws and regulatory guidelines, ~~and~~ 3) new knowledge about the impacts or 4) as deemed as appropriate by the Council.

Policy Considerations

A key tenet of ecosystem-based fisheries management (EBFM) is the ~~explicit~~ consideration of potential indirect effects of fisheries, on food web linkages when~~such as through food web processes, when~~ developing harvest strategies and management plans. Examples of unintended consequences include the ~~This is crucial because of the high likelihood that fishing may lead to unintended and unforeseen consequences on the ecosystem. For example~~, over exploitation of predators, ~~can cause~~ an increase in abundance of their prey, and a decline of organisms two trophic levels below them, a phenomenon known as a trophic cascade (Carpenter et al. 1985). Alternatively, f~~F~~ishing on lower trophic level species, planktivorous "forage" fishes for example, may ultimately lead to predator population declines due to food limitation (e.g. Okey et al. 2014; Walters and Martell 2004). Food web linkages connect different components of the larger ecosystem, such as pelagic forage fishes and their piscivorous predators or~~to~~ demersal carnivores. This connectivity between food webs over space, time, and depth creates multiple energy pathways that enhance ecosystem stability and resilience. Food web models are increasingly being utilized by fisheries managers as ecological prediction tools because they provide the capability to simulate the entire ecosystem from primary producers to top predators to~~and~~ fisheries. Food web models can serve to inform single species assessment and management and are capable of generating reference points (Walters et al. 2005) and ecosystem-level indicators (Coll et al. 2006; Fulton et al. 2005).

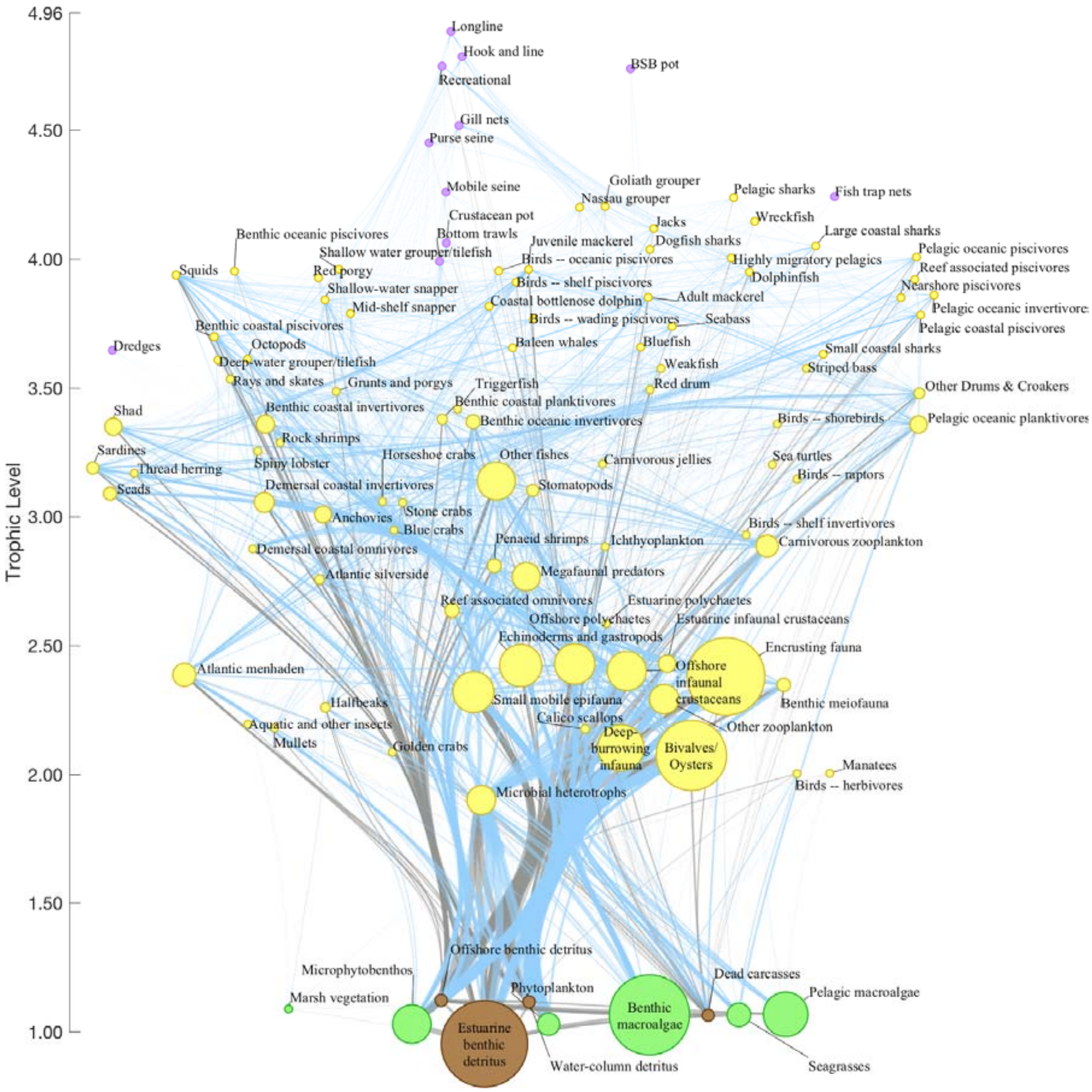

Figure 1-1. The marine food web of the South Atlantic Bight, based on the latest iteration of the SAB Ecopath model as described in Okey et al (2014), based originally on a preliminary model by Okey and Pugliese (2001). Nodes are colored based on type (green = producer, brown = detritus, yellow = consumer, purple = fleet). Blue for all edges except flows to detritus, which are gray. Diagram produced by Kelly

Kearney, UW Joint Institute for the Study of the Atmosphere and Ocean and NOAA Alaska Fisheries Science Center, April 2015.

Threats to EFH and EFH-HAPCs from Changes in South Atlantic Food Web and Connectivity

The SAFMC finds that negative impacts to EFH and EFH-HAPCs can changes in South Atlantic food webs and connectivity potentially impacts EFH and EFH-HAPCs for managed species. Table 1 following food webs and connectivity policy and research recommendations, presents a summary of South Atlantic fisheries and their designated EFH and EFH-HAPCs essential fish habitat designations potentially affected by changes in South Atlantic food webs and connectivity as presented in the SAFMC EFH User Guide (http://safmc.net/download/SAFMCEFHUsersGuideFinalNov16.pdf).

SAFMC Policies Addressing South Atlantic Food Webs and Connectivity

The SAFMC establishes the following policies to address South Atlantic food webs and connectivity, and to clarify and augment the general policies already adopted in the Habitat Plan and Comprehensive Habitat Amendment and Fishery Ecosystem Plan (SAFMC 1998a; SAFMC 1998b; SAFMC 2009a).

General Policies:

1. **Forage Fisheries** – Managers should consider forage fish stock abundances and dynamics, and their impacts on predator productivity, when setting catch limits to promote ecosystem sustainability. To do so, more science and monitoring information areis needed to improve our understanding of the role of forage fish in the ecosystem. This information should be included in stock assessments, ecosystem models, and other fishery management tools and processes in order to support the development of sustainable harvest strategies that incorporate ecosystem considerations and trade-offs.
   Note: Initial preliminary definition and potential list of forage fish species presented in Appendix A.

2. **Food Web Connectivity** – Separate food webs exist in the South Atlantic, for example inshore-offshore, north-south, and benthic-pelagic, but they are connected by species that migrate between them such that loss of connectivity could have impacts on other components of the ecosystem that would otherwise appear unrelated and must be accounted for.

3. **Trophic Pathways** – Managers should aim to understand how fisheries production is driven either by bottom-up or top-down forcing and attempt to maintain diverse energy pathways to promote overall food web stability.

4. **Food Web Models** – Food web models can provide useful information to inform stock assessments, screen policy options for unintended consequences, examine

ecological and economic trade-offs, and evaluate performance of management actions under alternative ecosystem states.

5. **Food Web Indicators** – Food web indicators have been employed to summarize the state of knowledge of an ecosystem or food web and could serve as ecological benchmarks to inform future actions.

6. **Invasive Species** – Invasive species, most notably lionfish, are known to have negative effects on ecologically and economically important reef fish species through predation and competition and those effects should be accounted for in management actions.

7. **Contaminants** – Bioaccumulation of contaminants in food webs can have sub-lethal effects on marine fish, mammals, and birds and is also a concern for human seafood consumption.

Research and Information Needs Addressing South Atlantic Food Webs and Connectivity

1. Scientific research and collection of data to further understand the impacts of climate variability on the South Atlantic ecosystem and fish productivity must be prioritized. This includes research on species distribution, habitat, reproduction, recruitment, growth, survival, predator-prey interactions and vulnerability.

2. Characterization of offshore ocean habitats used by estuarine dependent ~~diadromous~~ species, which canmay be useful in developing ecosystem models.

3. Scientific research and monitoring to improve our understanding of the role of forage fish in the ecosystem, in particular abundance dynamics and habitat use.

4. Basic data are the foundation of ecosystem-based fisheries management thus, fixing existing data gaps in the South Atlantic must be addressed first in order to build a successful framework for this approach in the South Atlantic.

5. Development and evaluation of an initial suite of products at an ecosystem level to help prioritize the management and scientific needs in the South Atlantic region taking a systemic approach to identify overarching, common risks across all habitats, taxa, ecosystem functions, fishery participants and dependent coastal communities.

6. Development of risk assessments to evaluate the vulnerability of South Atlantic species with respect to their exposure and sensitivity to ecological and environmental factors affecting their populations.

7. Coordination of ongoing regional modeling and management tool development efforts to ensure that ecosystem management strategy evaluations (MSEs) link to multispecies and single species MSEs, inclusive of economic, socio-cultural, and habitat conservation measures.

8. Development of ecosystem-level reference points (ELRPs) and thresholds as an important step to informing statutorily required reference points and identifying key dynamics, emergent ecosystem properties, or major ecosystem-wide issues that impact multiple species, stocks, and fisheries. Addressing basic data collection gaps is critical to successful development of ELRPs.

~~3.~~ 9. Continued support of South Atlantic efforts to refine EFH and HAPCs is essential to protect important ecological functions for multiple species and species groups in the face of climate change.

Many ~~of the~~ habitats in the South Atlantic Region that are ~~and associated fisheries~~ susceptible to the effects of ~~affected by~~ climate variability ~~in the South Atlantic Region~~ have been identified as EFH-HAPCs by the SAFMC (Table 1). ~~as follows:~~

Table 1. Habitats designated as Essential Fish Habitat (EFH), their associated managed fisheries/species, and EFH-Habitat Atreas of Particular Concern. ~~Fisheries and Habitat Designations Potentially Affected by Climate Variability in the South Atlantic Region~~ (Source: SAFMC EFH Users Guide 2016).

Essential Fish Habitat	Fisheries/Species	EFH- Habitat Areas of Particular Concern
Wetlands		
Estuarine and marine emergent wetlands	Shrimp, Snapper Grouper	Shrimp: State designated nursery habitats Mangrove wetlands
Tidal palustrine forested wetlands	Shrimp	
Submerged Aquatic Vegetation		
Estuarine and marine submerged aquatic vegetation	Shrimp, Snapper Grouper, Spiny lobster	Snapper Grouper, Shrimp
Shell bottom		
Oyster reefs and shell banks	Snapper Grouper	Snapper Grouper
Coral and Hardbottom		
Coral reefs, live/hardbottom, medium to high rock outcroppings from shore to at least 600 ft where the annual water temperature range is sufficient.	Snapper Grouper, Spiny lobster, Coral, Coral Reefs and Live Hard/bottom Habitat	The Point, Ten Fathom Ledge, Big Rock, MPAs; The *Phragmatopoma* (worm reefs) off central east coast of Florida and nearshore hardbottom; coral and hardbottom habitat from Jupiter through the Dry Tortugas, FL; Deepwater CHAPCs
rock overhangs, rock outcrops, manganese-phosphorite rock slab formations, and rocky reefs		Snapper-grouper [blueline tilefish]
Artificial reefs	Snapper Grouper	Special Management Zones
Soft bottom		
Subtidal, intertidal non-vegetated flats	Shrimp	
Offshore marine habitats used for spawning and growth to maturity	Shrimp	
Sandy shoals of capes and offshore bars	Coastal Migratory Pelagics	Sandy shoals; Capes Lookout, Fear, Hatteras, NC; Hurl Rocks, SC;
troughs and terraces intermingled with sand, mud, or shell hash at depths of 150 to 300 meters		Snapper-grouper [golden tilefish]
Water column		
Ocean-side waters, from the surf to the shelf break zone, including Sargassum	Coastal Migratory Pelagics	
All coastal inlets	Coastal Migratory Pelagics	Shrimp, Snapper-grouper
All state-designated nursery habitats of particular importance (e.g., PNA, SNA)	Coastal Migratory Pelagics	Shrimp, Snapper-grouper
High salinity bays, estuaries	Cobia in Coastal Migratory Pelagics	Spanish mackerel: Bogue Sound, New River, NC; Broad River, SC
Pelagic Sargassum	Dolphin	

Gulf Stream	Shrimp, Snapper-grouper, Coastal Migratory Pelagics, Spiny lobster, Dolphin-wahoo	
Spawning area in the water column above the adult habitat and the additional pelagic environment	Snapper-grouper	

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Appendix A. Potential list of potential forage species and definition.

Note: Species highlighted constitute a preliminary list of non-managed forage fish species.

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Table 2.5

Abundance, biomass, and occurrence by species. Values are for 2006-2010 calendar years. Ranking is by total number of individuals. Top 50 species of 215

CommonName	Species	Number Rank	Total Number	% of Total Abundance	Biomass (kg)	%of Total BioMass	Number of Occurrences	% of Occurences	CumPct Number	Rank Biomass	CumPct Biomasss
Atl bumper	Chloroscombrus chrysurus	1	1368597	35.34	18645.26	6.76	979	61.57	35.34	5	46.21
Atl croaker	Micropogonias undulatus	2	467821	12.08	24544	8.89	871	54.78	47.42	2	25.33
spot	Leiostomus xanthurus	3	342689	8.85	19807.84	7.18	1121	70.5	56.27	3	32.51
white shrimp	Litopenaeus setiferus	4	141041	3.64	3779.69	1.37	809	50.88	59.91	14	64.34
striped anchovy	Anchoa hepsetus	5	140732	3.63	1244.2	0.45	961	60.44	63.54	27	73.97
moonfish	Selene setapinnis	6	128782	3.33	2173.18	0.79	1001	62.96	66.87	20	69.92
cannonball jellyfish	Stomolophus meleagris	7	127957	3.3	45368.66	16.44	723	45.47	70.17	1	16.44
scup/porgy	Stenotomus sp.	8	120165	3.1	4249.36	1.54	505	31.76	73.27	11	59.99
pinfish	Lagodon rhomboides	9	87700	2.26	4134.76	1.5	623	39.18	75.53	12	61.49
banded drum	Larimus fasciatus	10	68273	1.76	5041.15	1.83	775	48.74	77.29	9	56.81
butterfish	Peprilus triacanthus	11	68083	1.76	1801.7	0.65	852	53.58	79.05	22	71.34
star drum	Stellifer lanceolatus	12	67465	1.74	1279.21	0.46	462	29.06	80.79	26	73.52
Southern kingfish	Menticirrhus americanus	13	63683	1.64	6310.79	2.29	1181	74.28	82.43	7	52.86
harvestfish	Peprilus paru	14	61621	1.59	2706.34	0.98	986	62.01	84.02	16	66.41
Atl thread herring	Opisthonema oglinum	15	56675	1.46	1427.48	0.52	977	61.45	85.48	25	73.06
brown shrimp	Farfantepenaeus aztecus	16	49209	1.27	759.13	0.28	548	34.47	86.75	32	75.62
breif squid	Lolliguncula brevis	17	48151	1.24	555.35	0.2	1263	79.43	87.99	33	75.82
Atl cutlassfish	Trichiurus lepturus	18	46126	1.19	2442.13	0.88	599	37.67	89.18	19	69.13
silver seatrout	Cynoscion nothus	19	43987	1.14	2448.59	0.89	659	41.45	90.32	18	68.25
northern searobin	Prionotus carolinus	20	38652	1	430.23	0.16	712	44.78	91.32	34	75.98
weakfish	Cynoscion regalis	21	35781	0.92	3000.54	1.09	670	42.14	92.24	15	65.43
Atl menhaden	Brevoortia tyrannus	22	27118	0.7	842.86	0.31	206	12.96	92.94	30	75.04
spider crab	Libinia dubia	23	23998	0.62	74.19	0.03	496	31.19	93.56	44	76.6
squid sp	Loligo spp.	24	21515	0.56	316.24	0.11	485	30.5	94.12	36	76.22
bay anchovy	Anchoa mitchilli	25	20415	0.53	31.27	0.01	442	27.8	94.65	49	76.69
bluefish	Pomatomus saltatrix	26	20169	0.52	1763.96	0.64	531	33.4	95.17	23	71.98
silver perch	Bairdiella chrysoura	27	19695	0.51	826.85	0.3	292	18.36	95.68	31	75.34
inshore lizardfish	Synodus foetens	28	19482	0.5	1537	0.56	830	52.2	96.18	24	72.54
pigfish	Orthopristis chrysoptera	29	14141	0.37	1086.03	0.39	418	26.29	96.55	28	74.36
spadefish	Chaetodipterus faber	30	7942	0.21	369.7	0.13	416	26.16	96.76	35	76.11
Spanish mackerel	Scomberomorus maculatus	31	7906	0.2	1008.44	0.37	781	49.12	96.96	29	74.73
Atl sharpnose shark	Rhizoprionodon terraenovae	32	7778	0.2	4522.38	1.64	973	61.19	97.16	10	58.45
lady crab	Ovalipes stephensoni	33	5630	0.15	45.44	0.02	421	26.48	97.31	47	76.66
shortfinger anchovy	Anchoa lyolepis	34	5515	0.14	19.94	0.01	225	14.15	97.45	50	76.7
irridescenct swimming crab	Portunus gibbesii	35	5165	0.13	47.12	0.02	462	29.06	97.58	46	76.64
Atl lookdown	Selene vomer	36	5078	0.13	183.14	0.07	408	25.66	97.71	38	76.37
hogchocker	Trinectes maculatus	37	4903	0.13	161.57	0.06	296	18.62	97.84	39	76.43
windowpane	Scophthalmus aquosus	38	4137	0.11	100.84	0.04	410	25.79	97.95	41	76.51
bullnose ray	Myliobatis freminvillei	39	3844	0.1	12041.15	4.36	330	20.75	98.05	6	50.57
lesser blue crab	Callinectes similis	40	3774	0.1	45.23	0.02	375	23.58	98.15	48	76.68
bonnethead shark	Sphyrna tiburo	41	3670	0.09	4091.41	1.48	561	35.28	98.24	13	62.97
butterfly ray	Gymnura micrura	42	3561	0.09	2626.05	0.95	470	29.56	98.33	17	67.36
fringed flounder	Etropus crossotus	43	3514	0.09	80.22	0.03	575	36.16	98.42	42	76.54
cownose ray	Rhinoptera bonasus	44	3437	0.09	19154.01	6.94	196	12.33	98.51	4	39.45
king mackerel	Scomberomorus cavalla	45	3216	0.08	218.23	0.08	280	17.61	98.59	37	76.3
bluntnose stingray	Dasyatis sayi	46	2896	0.07	5847.42	2.12	490	30.82	98.66	8	54.98
spotted hake	Urophycis regius	47	2827	0.07	76.87	0.03	189	11.89	98.73	43	76.57
ocellated flounder	Ancylopsetta quadrocellata	48	2599	0.07	102.39	0.04	414	26.04	98.8	40	76.47
leopard sea robin	Prionotus scitulus	49	2498	0.06	62.75	0.02	284	17.86	98.86	45	76.62
clearnose skate	Raja eglanteria	50	2410	0.06	2138.9	0.77	300	18.87	98.92	21	70.69

(Source: SEAMAP-SA Report Project: NA06NMF435002: September 2012)

Forage species: fish—small, short-lived and fast growing mid-trophic level species—are primary energy pathways in many marine food webs, and that they support other valuable fish stocks and many species of marine birds and mammals. Forage fish are presumed to be important in the SAB because they are food for valuable commercial and recreational species in this ecosystem, in addition to supporting other species in the broader biological community. SAB forage fish groups include Atlantic menhaden(*Brevoortia tyrannus*), halfbeaks (*Hemiramphus spp., Hyporhamphus unifasciatus*), anchovies (*Anchoa spp., A. mitchilli, A. hepsetus, Engraulis eurystole*), sardines (*Harengula jaguana*, *Sardinella aurita*), Atlantic silverside (*Menidia menidia*), scads (*Decapterus punctatus*, *Trachurus lathami*, *Selar crumenophthalmus*), shad (*Alosa spp.*), Atlantic thread herring (*Opisthonema oglinum),* mullets (*Mugil spp.*), and other pelagic oceanic planktivores such as lanternfish (*Diaphus spp.*), antenna codlet (*Bregmaceros atlanticus*), striated argentine (*Argentina striata*), chub mackerel (*Scomber japonicus*), and flyingfish (Exocoetidae).

Note: Squids (*Illex illecebrosus*, *Loligo pealei*) and shrimps (rock shrimps and penaeid shrimps) in this system also serve as forage (Pauly 1998, Anderson and Piatt 1999, Okey 2006), as do krill (Euphausiacea). These forage groups exhibit widely varying importance, *e.g.*, interaction strengths, in the presently modelled context. (Source: Exploring the Trophodynamic Signatures of Forage Species in the U.S. South Atlantic Bight Ecosystem to Maximize System-Wide Values. Thomas A. Okey, Andrés M. Cisneros-Montemayor, Roger Pugliese, Ussif R. Sumaila)